...dvantaged business, HBCU or MI participation ...screte or severable areas of research in the ...standing in the Science of Military Manpower and ...ence BAA 95-01. General Evaluation and Award ...eview the proposals for scientific merit of the proposal ...al contributions of the proposed effort to the Government's ...posals not considered to have sufficient merit or relevance to the ...as or those in areas for which funds are not expected to be available ...ned without further review. Proposals as a result of industry/academic ...projects will not be evaluated against each other since they are not submitted ...cordance with a common work statement. The primary basis for selecting proposals ...r award shall be technical merit, importance to agency programs, and fund availability. Cost realism and reasonableness shall also be considered. Proposals as a result of Government issuance of solicitations will be evaluated based on techincal and price considerations. Technical areas are technical/management approach, personnel resources and manning, corporate experience/facilities. The complete evaluation criteria will be included in the Government provided solicitation, together with any other terms and conditions appropriate for the action. Proposals will be evaluated against each other. Every effort will be made to protect the confidentiality of the proposal and any evaluations. The submitter must mark the proposal with a protective legend if protection is desired for proprietary of confidential information. Part IV of the BAA provides forms to be submitted with the proposal. All responses to the CBD announcement must request BAA 95-01 for specific information about proposal preparation. Request is to be made in writing to Nancy Sexton, Code 890-2, P. O. Drawer 43018, MCLB, Albany, GA 31704-3018. (0342)

Office of Naval Research, 800 N. Quincy Street Arlington, VA 22217-5660

A -- MULTIDISCIPLINARY RESEARCH PROGRAM OF THE UNIVERSITY RESEARCH INITIATIVE POC Point of Contact: D. Hughes, ONR 353, (703) 696-4111. The Department of Defense announces a competition for fiscal year 1995-1999 funding for the Multidisciplinary Research Program, one element of the University Research Initiative (URI). The Multidisciplinary Research Program of the URI (hereafter called "MURI") will support research teams whose efforts intersect more than one traditional science and engineering discipline. Such team efforts can accelerate research progress in areas particularly suited to this approach. Further, MURI programs are expected to promote application of defense research, principally for defense purposes, but also for commercial purposes. Only non-federal U.S. academic institutions of higher education with degree-granting programs in science and engineering are eligible to submit proposals. This FY 95 MURI competition is in fourteen specific research topics: (1) Functionally Tailored Textile Fabrics; (2) Computational Geometry for Intelligent Systems; (3) Low-Power/Low-Noise Electronics; (4) Intelligent Turbine Engines; (5) Manufacturable Power Switching Devices; (6) Autonomous Oceanographic Sampling Networks; (7) Advanced Biosensor Arrays; (8) Advanced Optical Materials; (9) Reduced Signature Target Recognition; (10) Materials and Processing at the Nanometer Scale; (11) Computational Electromagnetics; (12) Therapeutics for Advanced Trauma Care; (13) Advanced Optoelectronic Components for Broadband Communication; (14) Novel Energetic Materials to Stabilize Rockets. Awards will be made by the Army Research Office, the Office of Naval Research, the Air Force Office of Scientific Research, the Advanced Research Projects Agency, and the Ballistic Missile Defense Organization. This notice constitutes a Broad Agency Announcement as contemplated in FAR 6.102(D)2. Typically, each award is expected to be (a) for a basic period of three years, with two additional years possible as options; (b) funded incrementally or as options; (c) in the range of $1 million to $3 million per year; (d) subject to the availability of FY 96-99 funds. Collectively, the agencies plan to award $25 million in FY95 funds for the first year of these awards, and comparable amounts for each year thereafter (FY 96-99). White papers, limited to five pages, must be received by the appropriate points of contact by 4 p.m. Eastern time on Friday, 13 January 1995. Invitations for follow-up proposals will be communicated directly to the Principal Investigator by about 2 February 1995 with proposals due Friday, 10 March 1995. A brochure describes the research interests on which the fourteen topics are based, the technical points of contact, as well as conditions regarding industry participation, consortia, and collaborations. It also describes proposal preparation, evaluation criteria, and deadlines. Brochures have been distributed to sponsored programs offices nationwide. Alternatively, the brochure may be accessed through the Federal Information Exchange (FEDIX). Access FEDIX through computer and modem at 800-783-3349 or 301-258-0953, through Internet (Telnet, FTP or Gopher to "fedix.fie.com" and at log-in type "fedix"), or through WorldWide Web at "HTTP: web.fie.com." The FEDIX helpline is 301-975-0103. The brochure may be found in the Procurements and Special Notices section from the ONR menu. Lastly, brochures may be obtained by sending a self-addressed mailing label to Office of Naval Research, Code 353 (MURI'95), 800 North Quincy Street, Arlington, VA 22217-5660. Expect mailings to take 2-3 weeks. (0342)

The **Commerce Business Daily** (USPS 966-360) is published daily, except Saturdays, Sundays and holidays, for $324.00 a year (1st Class mailing) or $275.00 a year (2nd Class mailing) by the U.S. Government Printing Office, Washington, DC 20402. Second Class postage paid at Washington, DC and additional mailing offices. POSTMASTER: Send address changes to Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402-9373, with entire mailing label from last issue received.

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Goddard Space Flight Center, Code 287, Greenbelt, MD 20771

A -- AUTONOMOUS STAR TRACKER FOR SOUNDING ROCKET FLIGHT SOL RFP5-14754/237 DUE 010295 POC Lorrie L. Eakin, Contract Specialist, (301) 286-4241 or, Bradley J Poston, Contracting Officer, (301) 286-6843. NASA/GSFC intends to issue Request for Proposal (RFP)5-14754/237 on or about January 2, 1995 on a sole source basis for a firm fixed price to Lockheed Missiles and Space Company's Palo Alto Research Laboratory. Lockheed shall develop, test, and deliver one Autonomous Star Tracker (AST) that uses a Charged Coupled Device (CCD) for a detector and autonomously recognizes the inertial orientation of its boresight axis. The AST shall be delivered to Goddard Space Flight Center (GSFC) for integration into a sounding rocket as an experimental payload. The star tracker must be capable of surviving the sounding rocket flight environments and delivering data to the rocket's telemetry system. The flight will attempt to prove that the unit can operate in the "stars in, quaternion out" mode. The star tracker must be capable of performing autonomous inertial attitude recognition without a priori attitude knowledge. The star tracker specifications include: 1) The field of view shall be a minumum of 64 square degrees and shall be nominally square; 2) Systematic errors for individual stars shall be corrected within the tracker, as needed, such that each axis of the measured tracker output, exclusive of NEA, shall be less than 10 arc seconds from the true star position in the tracker coordinate frame. No additional, external calibration shall be required to meet this specification, nor shall any correction be required for stars of various spectral characteristics. Accuracy of the quaternion output shall be less than 1 arc second from the true inertial orientation. The one sigma error in a single star position measurement defined as Noise Equivalent Angle (NEA) in each axis shall not exceed 5 arc seconds; 3) The star tracker shall provide instrument magnitude information for each star being tracked to an absolute accuracy of +/- 0.25 magnitude, one sigma. The relative accuracy between stars in the field of view shall be +/- 0.1 magnitude, one sigma; 4) The star tracker shall provide position and magnitude information at a 5 Hz rate, minimum, when tracking stars; 5) The star tracker shall acquire, track and provide inertial data within 30 seconds of receiving a search command under all specified flight environmental conditions; 6) The star tracker including internal harnessing and light shade shall weigh less than 5 kg; and 7) The star tracker shall consume less than 10 watts under worst case conditions when used with the 28+/-7 volt spacecraft bus. The unit is to be delivered within 7 months with 3 months of pre and post launch support. The statutory authority for this procurement is 10 U.S.C. 2304 (c)(1), Only One Responsible Source. Any other persons desiring consideration are requested to fully identify their capabilities in writing, within fifteen (15) days of the publication of this synopsis to the GSFC Contracting Officer listed above. See Numbered Note(s): 22. (0342)

NCCOSC RDTE Division Code 02214B 53570 Silvergate Avenue Bldg A33 San Diego CA 92152-5113

A -- MAINTENANCE SUPPORT ACDS AND CDES SOL N66001-95-R-0060 POC Contract Specialist, Patricia Oliver, (619)553-2333. Contracting Officer, Pam Howard. Bid Clerk. J.C. Norris, (619)553-4331. The Naval Command Control and Ocean Surveillance Center RDT&E Division (NCCOSC RDT&E Division) intends to procure on-site Maintenance Support (field engineering services) for the Advanced Combat Direction System Development and Evaluation sites (CDES) located in the NRaD Command, Control, and Communication Systems Integration Test and Evaluation complex, Building 600-C, and in the Fleet Combat Training Center complex, Building C-60. Field engineering services include performing maintenance (both preventative and corrective), modifications, operational checkout, and installation of new or existing equipment (tactical displays, computer systems, peripherals and support equipment) as required. Maintenance shall be performed on a daily basis and field engineering personnel shall also perform routine operation functions to include system start-up and shut-down, initiation of software systems, mountig of tapes and disks, manual data entry on both system and analyst's terminal and operation of interconnection devices such as the AN/USQ-62 High Speed Digital Switch. Support shall be provided five days per week, 3 shifts per day, for labs in building C60 and seven days per week, 3 shifts per day, for labs 350/360 in building 600. Field engineering support shall also include: liaison with the tactical display manufacturer's factory, computer manufacturer's factory, and peripheral manufacturer's factory; providing special technical documentation and reports, problem analysis reports and procuring emergency spare parts. The requirement is for a one (1) year base period and four (4) option periods of one (1) year each. It is estimated that 57,940 hours will be expended in the base period and 57,940 hours will be expended for each option year thereafter. A Time and Material contract is anticipated. The Government shall provide on-site facility space located in Building C-60 and Building 600. Specific information regarding government provided facilities will be included in the solicitation. All facilities utilized by the contractor in performance of this contract shall have clearance to the SECRET level. Contractor personnel working on-site must have a SECRET security clearance in accordance with the contract security classification specification which will be included as an attachment to the solicitation. NOTE: The Government will not pay relocation cost. The solicitation document is to be issued on or about 2/15/95 and close on or about 3/15/95. Interested parties are invited to respond to this synopsis. All responsible parties responses will be considered. For copies of solicitations only written request will be honored. (0342)

NASA, Johnson Space Center , BH2 , Houston, TX

A -- ORBITAL RADAR MEASUREMENT AND ANALYSIS SUPPORT SOL 9BH205-5-01P POC SHARI MILLER, Tel:713-483-8504 Contracting Officer:SHARI MILLER, Tel:713-483-8504 The Government contemplates a 3-year contract with XonTech, Van Nuys, CA, to conduct engineering analysis, requirements definition, design trade algorithm development, experiment planning, Orbital Debris Analysis System (ODAS) maintenance, upgrade, test, & verification for the character- ization of the orbital debris environment. NASA's ODAS can process and analyze data from the Haystack & Haystack Auxiliary radar systems to determine the debris flux as a function of size & orbital elements. ODAS was developed to allow debris data from other DoD radar systems to be integrated into the processing algorithms & the historically evolvin... debris data base contained within the system. Expansion of the system to include shap... & mass requires a thorough knowledge of the current debris radar data processin... system & hardware/software architecture; experi- ence with each current and/or futur... debris measurement radar system and its capabilities & planned modes of operation... background in the debris radar measurement program, algorithms to process, reduce ... analyze data from mechanical & phased array radar systems; demonstrated success a... up- grading & integrating modifications into a complex system of Silicon Graphic... hardware & special purpose application software. NASA requires the vendor posses... absolute familiarity & detailed knowledge of current & anticipated radar systems whic... will be providing future debris measure- ment data. XonTech is the only know... company which has the necessary ex- pertise & detailed knowledge of this system... XonTech developed the cur- rent ODAS software including the size estimation algorithm... & has unique knowledge & access to perform upgrade modifications to accommodat... addi- tional systems & to expand the analysis to include shape & mass. The Governmer... anticipates a sole source contract award by February 1995. This procurement is bein... conducted under the NASA/JSC MidRange Test Pro- gram approved by the Office ... Federal Procurement Policy on 4/16/94. See Note 22. (0342)

B Special Studies and Analyses - Not R&D - Potential Sources Sought

Commander, Naval Sea Systems Command, 2531 Jefferson Davis Highway, Arlington, VA 22242-5160

B -- NAVY AIR DEFENSE SURVEILLANCE PROGRAM WHITE PAPER POC Bill Arcidiacono, (0254R); (703)602-7900; Contracting Officer, Michael Gutermuth (0254), (703)602-7900; Captain M. Cassidy, (202)767-3403. The Navy ha... established a Surveillance Technology Insertion Team (STIT) to identify, advocate an... facilitate technology insertion opportunities for all Navy Air Defense surveillance programs and is interested in developing a focused approach to expedite system... transition of ongoing air defense surveillance system technology. To meet that objective we are soliciting industry to submit white papers, not in excess of three pages, tha... describe ongoing advanced air defense surveillance system programs which may be o... interest to the STIT. Each white paper should be formatted to include the following Program Title: (Official Title plus acronym); Executing Agent: (By organization and nam... plus telephone number); Operating Environment: (Space, Airborne, Surface); Funde... By: (Government Agency Name/Commercial IRAD/other); Summary: (One paragrap... summary of program); Concept of Operations: (How used in operational system) Description of System: (Provide system details); Technical: (Risk/technica... achievements/expected performance/etc...); Transition: (Present and futur... opportunities); Funding: (Past, present and added requirements); There is no prese... funding appropriated for this effort and therefore no award will result from thi... announcement, however, the Navy intends to pursue more detailed interactions in th... future. Interested parties should submit white papers by 6 January 1995 t... Commanding Officer, Naval Research Laboratory, 4555 Overlook Ave, S.W. Washington, D.C. 20375. (0342)

C Architect and Engineering Services - Construction

DA, Tulsa District, Corps of Engineers, POB 61, Tulsa, OK 74121-0061 ATTN:A-E Contracts & Documents Section

C -- B-2 ADDITION TO HANGAR FIRE PROTECTION, BUILDING 24C... TINKER AIR FO RCE BASE, OKLAHOMA POC Contact: Sheron Carpenter, A-... Contracts/Documents Section, 1645 S. 101 E. Ave, Tulsa, OK 74128, 918/669-704... 1. CONTRACT INFORMATION: A firm fixed-price architect-engineer contract will b... negotiated for producing final design and construction phase services (Option) f... subject project. This procurement is unrestricted. The anticipated contract award date ... January 24, 1995 and the final design completion date is August 1995. If a lar... business is selected for this contract, it must comply with FAR 52.219-9 regarding t... requirement for a subcontracting plan on that part of the work it intends to subcontra... For your information, the subcontracting goals for Tulsa District are 60% for sm... business and 9.8% for small disadvantaged business. The plan is not required with t... submittal. 2. PROJECT INFORMATION: Key elements of this project are modification ... existing aircraft maintenance hangar to provide fire suppression system and adaptati... as a fuel cell repair hangar. System to be preaction (closed head) aqueous film formi... foam AFFF monitor nozzles, and combustible and toxic gas detection/alarm syste... Building alterations include trench drain, vapor tight electrical wiring piping a... necessary utilities. Title II services may be required as a part of this contract. ... partnering commitment will be required. The estimated construction cost is between ... million and $10 million. 3. SELECTION CRITERIA: See Note 24 general selecti... process. The selection criteria in descending order of importance are: a. Qualif... registered professional personnel with experience in the following disciplines, but ... limited to : fire protection, mechanical, electrical, structural, civil and architectural; ... Specialized experience and technical competence in (1) fire protection system, ... building modification design, (3) construction cost estimating and preparation ... estimates on IBM-Compatible personal computers using Corps of Engineers Compu... Aided Cost Estimating System (M-CASES Gold) (software provided), (4) producing CA... drawings using either Intergraph IDGS, Micro Station 32, or Micro Station PC, ... producing quality designs, (6) ability to access a Computerized Automated Rev... Management System (ARMS) via modem, and (7) construction phase service... Sufficient capacity to submit the final design by August 1995; d. Past performanc... DOD and other contracts with respect to cost control, quality of work and complia... with delivery schedules; e. Volume of DOD contract awards in the last 12 month...

CERTIFICATIONS

The following certifications apply to Proposal Entitled:
"Manufacturable Power Switching Devices"

The undersigned certifies, to the best of his or her knowledge and belief, that:

(a) Pursuant to the requirements of OMB Circular A-129, this organization certifies that it is not delinquent on any Federal debt.
(b) Pursuant to Executive Order 12549 and implementing rule, this organization certifies that it presently is not debarred, suspended, proposed for debarment, declared ineligible or voluntarily excluded from covered transactions by any Federal department or agency.
(c) Pursuant to PL 100-690 and implementing final rule, effective 24 July 1990, this organization certifies that it will provide a drug-free workplace. The place of performance is:

Purdue University, West Lafayette, IN 47907, Tippecanoe County

Street Address City, County, State, Zip Code

2. The following certification applies only to actions exceeding $100,000:

Section 1352, Title 31, U.S.C. (PL 101-121, Section 319) entitled "Limitation on use of appropriated funds to influence certain Federal contracting and financial transactions".

(1) No Federal appropriated funds have been paid or will be paid by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of an agency, a Member of Congress, an Officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, "Disclosure Form to Report Lobbying", in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers (including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements) and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by Section 1352, Title 31, U.S.C. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

Louis Pellegrino, Associate Director [redacted]
Typed Name and Signature of the Officer responsible for this transaction

Purdue Research Foundation July 10, 1995
Organization Date

Purdue University

School of Electrical
and Computer Engineering

July 7, 1995

Dr. Al Goodman
Office of Naval Research, ONR-312
800 North Quincy Street
Arlington, VA 22217-5660

Dear Dr. Goodman:

The enclosed proposal entitled "Manufacturable Power Switching Devices" is being submitted in response to the BAA in the Commerce Business Daily of 12 December 1994 for the Multidisciplinary Research Program of the University Research Initiative.

Sincerely,

[redacted]

James A. Cooper, Jr.
Professor of
Electrical Engineering

PURDUE RESEARCH FOUNDATION

September 20, 1995

DIVISION OF
SPONSORED PROGRAMS

Ms. Curtissa Coleman
Office of Naval Research
800 North Quincy Street
Arlington, VA 22217-5660

RE: ONR Proposal Submitted by James A. Cooper
"Manufacturable Power Switching Devices"
DSP Ref No.: Y165

Dear Ms. Coleman:

This is in reply to your inquiries about the relationship between Purdue Research Foundation (PRF) and Purdue University (PU).

The Purdue Research Foundation was established in 1930 to perform in areas where it is inherently more difficult for Purdue University to function because of federal and state legislation that govern a land-grant university. PRF is a nonprofit corporation that administers trusts, funds and endowments; submits and helps to negotiate grants and contracts for Purdue University Principal Investigators; facilitates the issuance of patents on University faculty developments; accepts gifts; acquires and develops property; and performs other services helpful to Purdue University. PRF's objectives are exclusively to aid Purdue University.

In an Agreement signed by the Boards of Trustees of Purdue University and Purdue Research Foundation on July 1, 1959, Purdue University agreed to provide the personnel and facilities necessary to carry on the investigations and research projects which are proposed by Purdue University faculty and submitted on their behalf by the Purdue Research Foundation to public or private organizations outside the University.

I trust that the above information will clarify the relationship between Purdue University and Purdue Research Foundation satisfactorily. If I can be of further assistance to you, please feel free to call me at (317) 494-6205.

Sincerely,

(b) (6) [redacted]

Louis Pellegrino, Ph.D.
Associate Director

Ref: 530 1285-1348

1021 HOVDE HALL • WEST LAFAYETTE, IN 47907-1021
(317) 494-6200 • TELEFAX (317) 494-8323

PURDUE UNIVERSITY

School of Electrical and
Computer Engineering

Date: 8/30/95

FACSIMILE TRANSMITTAL

TO:

Name: Ms Curtissa Coleman

Location: ONR

Telephone: (703) 696-4516 **FAX:** (703) 696-0993

FROM:

Name: Prof Cooper

Location: Purdue University

Telephone: (317) 494- 3514 **FAX:** (317) 494-6441

Total number of
pages (including cover): 19

Additional information:

1285 Electrical Engineering Building • West Lafayette, IN 47907-1285

Purdue University

School of Electrical
and Computer Engineering

August 30, 1995

Ms. Curtissa Coleman
Office of Naval Research
800 N. Quincy St.
Arlington, VA 22217-5660

Phone: (703) 696-4516
FAX: (703) 696-0993

Dear Ms. Coleman:

I am FAXing a revised budget (consisting of new pages for the overall contract and for Cree Research) along with travel justification information for Purdue University and the four sub-contractors on our MURI program on Manufacturable Power Switching Devices. If everything seems in order, I will send these pages to get official university signatures and have the signed versions sent to you via Federal Express.

Please call me at (317) 494-3514 if you find anything wrong or missing with these pages. I will wait to hear from you before sending these pages for university signatures.

Thank you for your help in this matter.

Sincerely,

[redacted]
James A. Cooper, Jr.
Professor of Electrical and
Computer Engineering

1285 Electrical Engineering Building • West Lafayette, IN 47907-1285
PHONE (317) 494-3514 • FAX (317) 494-6441 • E-MAIL: cooperj@ecn.purdue.edu

13. Cost Proposal

A detailed budget follows. Below is a discussion of the travel and capital funds requested, and of the cost sharing.

The travel funds in the budget will be used to attend scientific meetings for the purpose of presenting the developments of this program and keeping abreast of developments in the areas of power devices and silicon carbide/III-V nitride materials. Travel funds will also be used to attend any program reviews and for any necessary meetings between the subcontractors and Purdue.

The University of Texas at Austin is budgeting for three items of capital equipment in the first year. The first items are mass flow controllers required for modifications of the existing MOCVD system to provide for the installation of additional dopant sources. The second item is a vacuum pump required for additional pumping speed because of the high flow rates of ammonia and hydrogen. The third item is a dewar required for variable-temperature Hall effect measurements and variable-temperature photoluminescence studies.

Howard University requests capital funds in the first year for an atomic force microscope (AFM). The AFM will be used to analyze the nature of the surface right after initiating growth.

Rensselaer Polytechnic Institute is requesting capital funds for two items. In the first year RPI will purchase a parametric analyzer, which will be used for static characterization of devices such as pn diodes and bipolar junction transistors. In the second year RPI will purchase a pulse generator, capacitance-voltage meter, and a personal computer to enable dynamic switching of power devices and capacitance-voltage measurements of MOS structures and Schottky diodes. The computer will allow interfacing of the various pieces of equipment for data acquisition.

Purdue University requests capital equipment funds in the first year of this program for the purchase of an LCR meter for MOS interface characterization and a vacuum annealing furnace for ohmic contact annealing. In the second year we request capital equipment funds to purchase an additional Micromanipulator probe station and new thermal oxidation tubes for MOS interface optimization.

Purdue University will provide $50,000 per year ($250,000 during the five years of the MURI) in cost sharing. Rensselaer Polytechnic Institute will contribute an amount equal to approximately 20% of their budget in the form of cost sharing. This amounts to about $40,000 per year for five years. Cree Research will provide cost sharing in the form of a 1:1 match of up to $100,000 per year ($500,000 during the five years of the MURI) for the purchase of material by the other members of this program. In addition, Cree will provide cost sharing in the form of a 1:1 match of $33,075 per year ($165,375 during the five years of the MURI) for the material that Cree uses in the pursuit of this program.

The **total cost sharing** during the five years of the MURI program by Purdue, RPI, and Cree will be approximately **$1,121,321.**

TOTAL BUDGET

				8/95-7/96	8/96-7/97	8/97-7/98	Sub-Total	8/98-7/99	8/99-7/00	Sub-Total	TOTAL
A. Salaries and Wages											
1. Senior Personnel											
J. Cooper	AY	35%		[redacted]							$210,640
	SS	2.0 mns									$110,024
M. Melloch	AY	25%									$118,012
	SS	1.5 mns									$72,695
J. Woodall	AY	10%									$67,990
	SS	1.5 mns									$104,703
J. Gray	AY	5%									$3,658
	SS	.5 mn									$3,805
2. Other Personnel											
P. Chin	FY	25%		[redacted]							$43,448
Grad Students	AY	50%	(9)								$691,122
	SS	3.0 mns	(9)								$211,483
Total Salaries & Wages				$296,938	$318,710	$331,458	$947,106	$338,468	$352,006	$690,474	$1,637,580
Grad fee remission				$20,799	$25,260	$27,640	$73,699	$30,260	$33,120	$63,380	$137,079
Total Compensation				$317,737	$343,970	$359,098	$1,020,805	$368,728	$385,126	$753,854	$1,774,659
B. Fringe Benefits											
Total fringe benefits				[redacted]							$215,883
C. Total Compensation and Fringes				$360,333	$385,643	$402,648	$1,148,624	$411,884	$429,834	$841,718	$1,990,542
D. Non-Personnel direct costs											
Communications				$2,000	$2,080	$2,163	$6,243	$2,250	$2,340	$4,590	$10,833
Travel - Domestic				$11,000	$13,520	$14,061	$38,581	$14,623	$15,208	$29,831	$68,412
Travel - Foreign				$4,000	$0	$4,000	$8,000	$0	$0	$0	$8,000
Publication & Duplication				$6,000	$6,240	$6,490	$18,730	$6,749	$7,019	$13,768	$32,498
Supplies & Expenses				$73,462	$75,520	$80,015	$228,997	$82,829	$89,617	$172,446	$401,443
Scientific Equipment				$54,442	$64,557	$0	$118,999	$0	$0	$0	$118,999
SIC Purchases				$100,000	$100,000	$100,000	$300,000	$100,000	$65,000	$165,000	$465,000
Sub-Contracts											
University of Texas				$422,136	$416,284	$432,559	$1,270,979	$440,194	$457,783	$897,977	$2,168,956
Cree Research				$275,962	$286,113	$295,913	$857,988	$295,478	$294,420	$589,898	$1,447,886
RPI				$199,999	$200,001	$200,001	$600,001	$190,247	$189,839	$380,086	$980,087
Howard University				$249,948	$249,712	$249,647	$749,307	$239,948	$239,473	$479,421	$1,228,728
Total non-personnel direct costs				$1,398,949	$1,414,027	$1,384,849	$4,197,825	$1,372,318	$1,360,699	$2,733,017	$6,930,842
E. Total direct cost				$1,759,282	$1,799,870	$1,787,497	$5,346,649	$1,784,202	$1,790,533	$3,574,735	$8,921,384
F. Indirect cos[redacted]f MTD cost				[redacted]							$1,528,616
G. Total cost				$2,090,000	$2,090,000	$2,090,000	$6,270,000	$2,090,000	$2,090,000	$4,180,000	$10,450,000

Subcontract - Cree Research Incorporated

Total Base Contract Cost: $977,058 Cost of Base to Government: $857,988 Cost of Option to Government: $589,898

	8/95-7/96	8/96-7/97	8/97-7/98	Sub-Total	8/98-7/99	8/99-7/00	Sub-Total	TOTAL
1. Clean Room Processing	$50,000	$50,000	$50,000	$150,000	$50,000	$50,000	$100,000	$250,000
2. Package & Test Department Costs								
Direct Labor Hours	200	200	300		300	300		
P & T Technicians ($11.25/hr)	$2,250	$2,340	$3,650	$8,240	$3,796	$3,948	$7,744	$15,984
Total P & T Labor	$2,250	$2,340	$3,650	$8,240	$3,796	$3,948	$7,744	$15,984
P & T Fringes ([redacted] x Base)	$637	$663	$1,034	$2,334	$1,075	$1,118	$2,193	$4,527
P & T Overhead [redacted] x Base)	$3,474	$3,613	$5,636	$12,723	$5,861	$6,096	$11,957	$24,680
Total P & T Department Costs	$6,361	$6,616	$10,320	$23,297	$10,732	$11,162	$21,894	$45,191
3. Mfg. Admin. Expenses = Total Direct Costs x [redacted]	$8,460	$8,498	$9,054	$26,012	$9,116	$9,180	$32,144	$58,156
Total Mrg. Direct Costs + Mfg. Overhead	$64,821	$65,114	$69,374	$199,309	$69,848	$70,342	$154,038	$353,347
4. R & D Department Costs								
R & D Labor Hours	200	200	200		200	200		
PI - John W. Palm[redacted]								$51,044
PM - Calvin Carter								$43,099
Ranbir Singh								$169,260
Doug Waltz								$45,810
Total R & D Labor	$57,218	$59,507	$65,374	$182,099	$62,311	$64,803	$127,114	$309,213
R & D Fringe & Occupancy ([redacted] x Base)	[redacted]							$87,600
R & D Overhead (29.78% x Base)	$17,040	$17,721	$19,468	$54,229	$18,556	$19,298	$37,854	$92,083
Total R & D Department Costs	$90,468	$94,C86	$103,362	$287,916	$98,520	$102,460	$200,980	$488,896

Subcontract - Cree Research Incorporated

5. Services								
Ion Implantation	$4,400	$4,400	$4,400	$13,200	$4,400	$4,400	$8,800	$22,000
Poly Si Deposition	$9,000	$9,000	$9,000	$27,000	$9,000	$9,000	$18,000	$45,000
Deposited Oxide	$10,000	$10,000	$10,000	$30,000	$10,000	$10,000	$20,000	$50,000
Total Services	$23,400	$23,400	$23,400	$70,200	$23,400	$23,400	$46,800	$117,000
6. Supplies and Materials								
a. SiC Wafers w/ Epi (Catalog Pricing)	$79,380	$79,380	$79,380	$238,140	$79,380	$79,380	$158,760	$396,900
b. Photomasks	$10,000	$10,000	$10,000	$30,000	$10,000	$10,000	$20,000	$50,000
Total Supplies and Materials	$89,380	$89,380	$89,380	$268,140	$89,380	$89,380	$178,760	$446,900
7. Travel	$7,594	$12,254	$7,594	$27,442	$12,254	$7,594	$19,848	$47,290
Total Direct Cost and Overhead	$275,663	$284,234	$293,110	$853,007	$293,402	$293,176	$600,426	$1,453,433
8. G & A Expenses								
([redacted] x Total Direct Cost)	$33,438	$34,476	$35,554	$103,470	$35,590	$35,562	$96,068	$199,538
Subtotal	$309,101	$318,712	$328,664	$956,477	$328,992	$328,738	$696,494	$1,652,971
9. Facilities Capital Cost of Money	$6,551	$7,091	$6,939	$20,581	$6,176	$5,372	$11,548	$32,129
Total Cost	$315,652	$325,803	$335,603	$977,058	$335,168	$334,110	$708,042	$1,685,100
Less Cost Sharing	$39,690	$39,690	$39,690	$119,070	$39,690	$39,690	$79,380	$198,450
Cost to Government	$275,962	$286,113	$295,913	$857,988	$295,478	$294,420	$628,662	$1,486,650

Travel Justification for Purdue University

Year 1 Domestic Travel

Semiconductor Interface Specialists Conf., Charleston, SC (December 1995)

Airfare	$500			
Lodging	$200			
Registration	$250			
Subsistence (3 days)	$250			

Total	$1200	x 1 person	=	$1200

WOCSEMMAD Conf., Sante Fe, NM (February, 1996)

Airfare	$700			
Lodging	$300			
Registration	$200			
Subsistence (3 days)	$200			

Total	$1400	x 1 person	=	$1400

Device Research Conf. and Electronic Mat'ls Conf., Santa Barbara, CA (June, 1996)

Airfare	$800			
Lodging	$350			
Registration	$250			
Subsistence (7 days)	$200 (some meals covered in lodging package)			

Total	$1600	x 3 people	=	$4800

MURI Program Review, Washington, DC

Airfare	$500			
Lodging	$200			
Subsistence (2 days)	$200			

Total	$900	x 2 people	=	$1800

Two (2) technical visits to Cree Research, Durham, NC

Airfare	$500			
Lodging	$200			
Subsistence (2 days)	$200			

Total	$900	x 1 person x 2 visits	=	$1800

TOTAL FOR YEAR 1 = $11,000

Year 2 Domestic Travel

Int'l Semiconductor Device Research Symp., Charlottesville, VA (December 1996)

Airfare	$500			
Lodging	$200			
Registration	$250			
Subsistence (3 days)	$250			

Total	$1200	x 1 person	=	$1200

Semiconductor Interface Specialists Conf., Location Unknown (December 1996)

Airfare	$500			
Lodging	$300			
Registration	$200			
Subsistence (3 days)	$250			

Total	$1250	x 1 person	=	$1250

WOCSEMMAD Conf., Location Unknown (February 1997)

Airfare	$700			
Lodging	$250			
Registration	$200			
Subsistence (3 days)	$200			

Total	$1350	x 1 person	=	$1350

Device Research Conf. and Electronic Mat'ls Conf., Boulder, CO (June 1997)

Airfare	$730			
Lodging	$400			
Registration	$200			
Subsistence (7 days)	$200 (some meals covered in lodging package)			

Total	$1530	x 4 people	=	$6120

MURI Program Review, Washington, DC

Airfare	$500			
Lodging	$200			
Subsistence (2 days)	$200			

Total	$900	x 2 people	=	$1800

Two (2) technical visits to Cree Research, Durham, NC

Airfare	$500			
Lodging	$200			
Subsistence (2 days)	$200			

Total	$900	x 1 person x 2 visits	=	$1800

TOTAL FOR YEAR 2	=	$13,520

Year 3 Domestic Travel

Int'l Semiconductor Device Research Symp., Charlottesville, VA (December 1997)

Airfare	$500			
Lodging	$300			
Registration	$250			
Subsistence (3 days)	$250			
Total	$1300	x 1 person	=	$1300

Semiconductor Interface Specialists Conf., Unknown Location (December 1997)

Airfare	$511			
Lodging	$400			
Registration	$200			
Subsistence (3 days)	$300			
Total	$1411	x 1 person	=	$1411

WOCSEMMAD Conf., Unknown Location (February 1998)

Airfare	$700			
Lodging	$300			
Registration	$200			
Subsistence (3 days)	$200			
Total	$1400	x 1 person	=	$1400

Device Research Conf. and Electronic Mat'ls Conf., Charlottesville, VA (June 1998)

Airfare	$470			
Lodging	$400			
Registration	$200			
Subsistence (7 days)	$200 (some meals covered in lodging package)			
Total	$1270	x 5 people	=	$6350

MURI Program Review, Washington, DC

Airfare	$500			
Lodging	$200			
Subsistence (2 days)	$200			
Total	$900	x 2 people	=	$1800

Two (2) technical visits to Cree Research, Durham, NC

Airfare	$500			
Lodging	$200			
Subsistence (2 days)	$200			
Total	$900	x 1 person x 2 visits	=	$1800

TOTAL FOR YEAR 3 = $14,061

Year 4 Domestic Travel

Int'l Semiconductor Device Research Symp., Charlottesville, VA (December 1998)

Airfare	$550			
Lodging	$400			
Registration	$250			
Subsistence (3 days)	$250			

Total	$1450	x 1 person	=	$1450

Semiconductor Interface Specialists Conf., Unknown Location (December 1998)

Airfare	$550			
Lodging	$323			
Registration	$200			
Subsistence (3 days)	$300			

Total	$1373	x 1 person	=	$1373

WOCSEMMAD Conf., Unknown Location (February 1999)

Airfare	$700			
Lodging	$300			
Registration	$200			
Subsistence (3 days)	$200			

Total	$1400	x 1 person	=	$1400

Device Research Conf. and Electronic Mat'ls Conf., Santa Barbara, CA (June 1999)

Airfare	$800			
Lodging	$400			
Registration	$200			
Subsistence (7 days)	$200 (some meals covered in lodging package)			

Total	$1600	x 4 people	=	$6400

MURI Program Review, Washington, DC

Airfare	$550			
Lodging	$250			
Subsistence (2 days)	$200			

Total	$1000	x 2 people	=	$2000

Two (2) technical visits to Cree Research, Durham, NC

Airfare	$550			
Lodging	$250			
Subsistence (2 days)	$200			

Total	$1000	x 1 person x 2 visits	=	$2000

TOTAL FOR YEAR 4 = $14,623

Year 5 Domestic Travel

Int'l Semiconductor Device Research Symp., Charlottesville, VA (December 1999)

Airfare	$550		
Lodging	$400		
Registration	$250		
Subsistence (3 days)	$250		
Total	$1450 x 1 person	=	$1450

WOCSEMMAD Conf., Unknown Location (February 2000)

Airfare	$708		
Lodging	$300		
Registration	$200		
Subsistence (3 days)	$200		
Total	$1408 x 1 person	=	$1408

Device Research Conf. and Electronic Mat'ls Conf., Boulder, CO (June 2000)

Airfare	$870		
Lodging	$400		
Registration	$200		
Subsistence (7 days)	$200 (some meals covered in lodging package)		
Total	$1670 x 5 people	=	$8350

MURI Program Review, Washington, DC

Airfare	$550		
Lodging	$250		
Subsistence (2 days)	$200		
Total	$1000 x 2 people	=	$2000

Two (2) technical visits to Cree Research, Durham, NC

Airfare	$550		
Lodging	$250		
Subsistence (2 days)	$200		
Total	$1000 x 1 person x 2 visits	=	$2000

TOTAL FOR YEAR 5	=	$15,208

Year 1 Foreign Travel

Int'l. Conf. on Physics of Semiconductors, Berlin (July 21-26, 1996)

Airfare	$1000		
Lodging	$400		
Registration	$200		
Subsistence (6 days)	$400		
Total	$2000 x 2 people	=	$4000

Year 3 Foreign Travel

Int'l. Conf. on Silicon Carbide and Related Compounds, Germany (October 1997)

Airfare	$1000		
Lodging	$400		
Registration	$200		
Subsistence (6 days)	$400		
Total	$2000 x 2 people	=	$4000

Travel Justification for the University of Texas at Austin

Conference	Location	Dates	Airfare	Lodging	Registr.	Subsist.	Total Cost	No. People	Total Trip
Dev. Res. Conf.	Santa Barbara CA	6/1/96 -- 6/4/96	500	350	250	200	1300	2	2600
Elect. Mat. Conf.	Santa Barbara CA	6/4/96 -- 6/6/96			295		295	2	590
ICMOVPE	Cardiff, Wales UK	4/1/96 -- 4/4/96	1200	300	350	210	2060	1	2060
MBE Conference	Pepperdine CA	10/1/96 -- 10/4/96	600	300	250	200	1350	1	1350
						*******	YEAR	1 TOTAL	= $6600
Dev. Res. Conf.	Golden CO	6/1/97 -- 6/4/97	750	350	250	200	1550	2	3100
Elect. Mat. Conf.	Golden CO	6/4/97 -- 6/6/97			300		300	2	600
OMVPE Workshop	Palm Springs CA	4/1/97 -- 4/4/97	750	300	350	174	1574	1	1574
MBE Workshop	Univ. Campus USA	10/1/97 -- 10/4/97	750	300	300	200	1550	1	1550
						*******	YEAR	2 TOTAL	= $6824
Dev. Res. Conf.	Charlottesville VA	6/1/98 -- 6/4/98	750	350	250	200	1550	2	3100
Elect. Mat. Conf.	Charlottesville VA	6/4/98 -- 6/6/98			325		325	2	650
ICMOVPE	Williamsburg VA	4/1/98 -- 4/4/98	750	400	375	200	1725	1	1725
MBE Workshop	Univ. Campus USA	10/1/98 -- 10/4/98	750	332	300	200	1582	1	1582
						*******	YEAR	3 TOTAL	= $7057

Dev. Res. Conf.	Santa Barbara CA	6/1/99 -- 6/4/99	750	350	275	200	1575	2	3150
Elect. Mat. Conf.	Santa Barbara CA	6/4/99 -- 6/6/99			325		325	2	650
OMVPE Workshop	Palm Springs CA	4/1/99 -- 4/4/99	750	400	356	200	1706	1	1706
MBE Workshop	Univ. Campus USA	10/1/99 -- 10/4/99	750	300	300	200	1550	1	1550
						*******	YEAR	4 TOTAL	= $7056

Dev. Res. Conf.	Boulder CO	6/1/00 -- 6/4/00	650	350	250	200	1450	2	2900
Elect. Mat. Conf.	Boulder CO	6/4/00 -- 6/6/00			325		325	2	650
ICMOVPE	Paris, France	4/1/00 -- 4/4/00	1300	300	350	248	2198	1	2198
MBE Workshop	Univ. Campus USA	10/1/00 -- 10/4/00	750	300	300	200	1550	1	1550
						*******	YEAR	5	= $7298

Travel Justification for Cree Research, Inc.

Item 7 - Travel

a. 1 Day 2 Person Trip to Washington, DC (2 per year)

Airfare - RDU to Washington National (RT) is $200 × 4 = $800

Per Diem - $35 × 4 = $140

b. 1 Day 3 Person Trip to Purdue (3 per year)

Airfare - RDU to West Layfayette (RT) is $538 × 6 = $3,228

Per Diem - $35 × 9 = $315

Lodging - $85 × 3 = $255

Rental Car - $40 × 3 = $120

c. 4 Day 2 Person East Coast Conference (1 per year)

Airfare - RDU to Boston (RT) is $620 × 2 = $1,240

Per Diem - $35 × 8 = $280

Lodging - $110 × 4 = $440

Rental Car - $44 × 4 = $176

Conference Registration Fee - $300 × 2 = $600

d. 4 Day 2 Person Overseas Conference (1 Year 2: 1 Year 4))

Airfare - RDU to Frankfurt (RT) is $1,400 × 2 = $2,800

Per Diem - $60 × 10 = $600

Lodging - $140 × 4 = $560

Other Transportation - $200

Registration Fee - $250 × 2 = $500

In Years 1, 3, and 5 the trips listed in a), b) and c) will be taken at a cost of $7,594 per year. In Years 2 and 4, we will attend the International Conference on Silicon Carbide and Related Materials, which will be held overseas in these years and is shown in d), in addition to those trips listed in a), b), and c) at a cost of $12,254 per year.

Travel Justification for Rensselaer Polytechnic Institute

Year 1

IEDM Washington, DC Dec., 1995

Airfare	$400		
Lodging	$250		
Registration	$200		
Subsistence (3days)	$150		
Total	$1000	x 2 people =	$2000
TOTAL FOR YEAR 1			$2000

Year 2

IEDM San Francisco, CA Dec., 1996

Airfare	$700		
Lodging	$300		
Registration	$200		
Subsistence (3 days)	$200		
Total	$1400	x 1 person =	$1400

Technical visit to Purdue University, June 1997

Airfare	$400		
Lodging	$200		
Subsistence (1 day)	$ 60		
Total	$ 660	x 1 person =	$ 660
TOTAL FOR YEAR 2			$2060

Year 3

IEDM Washington, DC Dec., 1997

Airfare	$500		
Lodging	$250		
Registration	$250		
Subsistence (3 days)	$200		
Total	$1200	x 2 people =	$2400

Technical visit to Purdue University, June 1998

Airfare	$462		
Lodging	$200		
Subsistence (1 day)	$ 60		
Total	$ 722	x 1 person =	$ 722

TOTAL FOR YEAR 3 $3122

Year 4

IEDM San Franscisco, CA Dec., 1998

Airfare	$758		
Lodging	$350		
Registration	$300		
Subsistence (3 days)	$200		
Total	$1608	x 2 people =	$3216

TOTAL FOR YEAR 4 $3216

Year 5

IEDM Washington, DC Dec., 1999

Airfare	$580		
Lodging	$250		
Registration	$250		
Subsistence (3 days)	$200		
Total	$1280	x 2 people =	$2560

Technical visit to Purdue University, June 2000

Airfare	$462		
Lodging	$200		
Subsistence (1 day)	$ 90		
Total	$ 752	x 1 person =	$ 752

TOTAL FOR YEAR 5 $3312

Travel Justification for Howard University

YEAR ONE

Device Research Conference and Electronic Materials Conference
Santa Barabara, California, June 1996 (1 trip/1 person)

Airfare	$ 800.00
Lodging	300.00
Registration	250.00
Sustenance (7 days)	155.00
	$1,505.00

Purdue University, West Lafayette, Indiana (2 trips/1 person) July, 1996
PURPOSE: Technical Discussion

Airfare	$ 400.00
Lodging	72.00
Sustenance (1 1/2 days)	40.00
	$ 512.00 (x 2 = $1,025)

TOTAL FOR YEAR 1 = $ 2530.00

YEAR TWO

Device Research Conference and Electronic Materials Conference
Boulder, Colorado, June 1997 (1 trip)

Airfare	$ 850.00
Lodging	350.00
Registration	250.00
Sustenance (7 days)	300.00
	$1,750.00

Purdue University, West Lafayette, Indiana (2 trips/1 person) July, 1997
PURPOSE: Technical Discussion

Airfare	$ 400.00
Lodging	100.00
Sustenance (1 1/2 days)	100.00
	$ 600.00 (x 2 = $1,200)

TOTAL FOR YEAR 2 = $ 2950.00

YEAR THREE

International Conference on SiC and Related Materials
Germany or Sweden, 1998 (1 trip/1 person)

Airfare	$ 1,000.00
Lodging	1,000.00
Registration	300.00
Miscellaneous (7 days)	305.00
	$2,600.00

Purdue University, West Lafayette, Indiana (1 trips/1 person) July, 1998
PURPOSE: Technical Discussion

Airfare	$ 400.00
Lodging	70.00
Sustenance (1 1/2 days)	30.00
	$ 500.00

TOTAL FOR YEAR 3 = $ 3100.00

YEAR FOUR

Device Research Conference and Electronic Materials Conference
Cornell University, Ithaca, New York (Tentative)

Airfare	$ 350.00
Lodging	325.00
Registration	250.00
Sustenance (7 days)	200.00
	$1,125.00 (x 2 = $2,250)

TOTAL FOR YEAR 4 = $ 2250.00

YEAR FIVE

Device Research Conference and Electronic Materials Conference
Santa Barbara, California, June 1996 (1 trip/1-1/4 people)

Airfare	$ 860.00
Lodging	350.00
Registration	250.00
Sustenance (7 days)	340.00
	$1,800.00 (x 1.25 = $2,250)

TOTAL FOR YEAR 5 = $ 2250.00

Jim Cooper from Purdue University

317-494-3514

information you asked for in ref

"ESTIMATED COST of Equipment"

Purdue year One ① LCR METER
$15,125

year one ② Vacum Annealing Furn.
$39,317

year two ① Micro Manipulator
Probe Station $34,557
② Thermal Oxidation
Tubes $30,000

RPI year One ① Parametric Analizer
$25,000

year two ① Pulse generator
$6,000
② CV Meter
10,000
③ Personal Computer
$2,000

University of Texas year one ① Mass Flow Controller
$5000
② Vacum Pump
15000
③ Optical Dewar
$8,000

2:50 pm

CREE

R E S E A R C H • I N C

2810 Meridian Parkway
Durham, N.C. 27713 USA

fax #: (919) 361-4630

telephone: (919) 361-5709

DATE: 8/18/95

FROM: John Bock

#PAGES: 8

COMPANY NAME:	Office of Naval Research	RE:	Requested Information
ATTENTION:	**Ms. Curtissa Coleman**	___	URGENT
FAX NUMBER:	(703) 696-0993	X	CONFIDENTIAL

SUBJECT PROPOSAL: Manufacturable Power Switching Devices

Per your request for additional information, please see attached pages. In this revised budget we used overhead rates based on our FY 1996 Budget. (Our fiscal year runs July 1 through June 30.) I have included a brief explanation of the pool and base for each of our overhead rates

I can be reached at the numbers above if I can provide any further assistance.

Cree Research, Inc.
Indirect Rate Structure

	Pool	Base
P&T Fringe Benefit Rate	Companywide Fringe Benefits Pool accumulated on general ledger	Companywide Labor Base accumulated on general ledger. Base is comprised of Indirect and Direct labor for all cost centers. Overtime & commissions are not part of an equitable base for allocating fringes.
P&T Overhead Rate	P&T Overhead Pool accumulated on general	P&T Labor Base accumulated on general ledger
Mfg. Admin. Overhead Rate	Mfg. Admin. Overhead Pool accumulated on general ledger	Total Mfg. Cost Input; includes Mfg. Cost Centers from Crystal Growth To P&T
R&D Fringe Benefit Rate	Companywide Fringe Benefits Pool accumulated on general ledger	See above.
R&D Overhead Rate	R&D Overhead Pool accumulated on general ledger; excluding IR&D items recovered in G&A Rate	R&D Labor Base accumulated on general ledger
G&A Overhead Rate	G&A Overhead Pool accumulated on general ledger; including IR&D items to be recovered in G&A Rate	Total Cost Input

Cree Research, Inc.
FY'96 Budgeted Overhead Rates

	POOL	BASE	FY'96 BUDGETED RATE	ACTUAL FY1995 RATE
Fringe Benefit Rate	[redacted]			
P&T Overhead Rate	261,374	169,281	[redacted]	
Mfg. Admin. Rate	873,766	5,821,681		
R&D Overhead Rate	469,034	1,574,735		
G&A Rate	1,636,597	13,497,040		

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Assuming Escalation Rate of 1.04 x pre yr rate
Historical + future expectations

MC

Company C75 | Company Name CREE RESEARCH, INC. | Period Ending 08/05/95 | Pay Date 08/11/95 | Weeks 32 | Batch 2256 | Page 0002 | 00105

AUTOPAY MASTER CONTROL

ADP

MC Company C75

ID/Personal Data	Pay Data	Tax Data	Schedule Amounts	YTD. QTD. Amounts and Other Accumulations	Miscellaneous Information
File Number 000001 OTHER LITERALS			REPORT BH2	CHECK/VOUCHER BAL. VACATION ALT:	REPORT CHECK/VOUCHER BH2

5585354
22484
40881
56338
15470
87512
10343
5600
2466
5600

Line	File Number	Social Security Number	Dept	Name	Sex	Stat	Dates	Current Gross	Pay	LWW	NWW
4	000132	[redacted]	400	WALTZ, DOUGLAS G. [redacted]	M	A	060188 / 060188	2686.26 / R 32 2442	BI-WEEKLY 3	32	32
4	000123	[redacted]	400	PALMOUR, JOHN W. [redacted]	M	A	010188 / 010188	3925.17 / R 47 153	BI-WEEKLY 3	32	32
	CONTD										
6	000108	[redacted]	400	CARTER, CALVIN H. [redacted]	M	A	120287 / 110187	4205.53 / R 50 4808	BI-WEEKLY 3	32	32
7	CONTD										
8											

612
976
340
313
219
117
32
32
51
241
16

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16340
10436
13953
5601
1661
954
80
490

INFORMATION

DATA PROCESSING, INC.

PERSONNEL ACTION

Date 5/23/95 (267)

Date Received
H/R ______
Acctg. ______

__Name Change
__Address Change

Ranbir ______ MI ______ Singh
First Name ______ MI ______ Last Name

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"Th[redacted]ormation contained in this document is [redacted]tary and confidential information of [redacted]search, Inc. and may not be disclosed, [redacted]ed or used in any manner without the prior written consent of the Company."

Soc. Sec. # ___-___-___

Birth Date ______
Mo./Day/Yr.

A[redacted]
City, State/Zip Code

Company Cree Department R+D Position/Title Power Device Scient

New Hire

Class: ✓Regular __Temporary
Hours: ✓Full-time __Part-time - #Hrs/Wk____
Status: ✓Exempt __Non-Exempt

Sex ✓Male __Female
Race __Caucasian __American Indian
__Black __Hispanic
✓Asian __Other

Date of Hire ~~about~~ August 1, 1995 Salary $65,000 Per year

Separation

*(Indicate detailed reason for separation in reasons/remarks)
__Resignation __Dismissal __Lay-off __Other Effective Date______

Termination/Vacation Pay: __Yes __No Amount/Type______
Re-employ recommended: __Yes __No

Salary/Job Change

Budgeted: __Yes __No
Separate Check: __Yes __No (If not checked, it will automatically be paid with the next payroll)
__Promotion __Transfer __Merit __Bonus: Amount______

Effective Date______ Salary: From______ To______

Present Position______ New Position______

Leave of Absence

__Disability __Medical __Suspension __Personal __Jury Duty __Military

Leave with Pay: Dates______ To______ #Hrs.____

Leave w/o Pay: Dates______ To______ #Hrs.____

Reasons/Remarks______

Requested [redacted] Title Vice President Date 5/23/95
Approved______ Title______ Date______

Item 7 - Travel

a. 1 Day 2 Person Trip to Washington, DC (2 per year)

Airfare - RDU to Washington National (RT) is $200 × 4 = $800

Per Diem - $35 × 4 = $140

b. 1 Day 3 Person Trip to Purdue (3 per year)

Airfare - RDU to West Layfayette (RT) is $538 × 6 = $3,228

Per Diem - $35 × 9 = $315

Lodging - $85 × 3 = $255

Rental Car - $40 × 3 = $120

c. 4 Day 2 Person East Coast Conference (1 per year)

Airfare - RDU to Boston (RT) is $620 × 2 = $1,240

Per Diem - $35 × 8 = $280

Lodging - $110 × 4 = $440

Rental Car - $44 × 4 = $176

Conference Registration Fee - $300 × 2 = $600

d. 4 Day 2 Person Overseas Conference (1 Year 2; 1 Year 4))

Airfare - RDU to Frankfurt (RT) is $1,400 × 2 = $2,800

Per Diem - $60 × 10 = $600

Lodging - $140 × 4 = $560

Other Transportation - $200

Registration Fee - $250 × 2 = $500

In Years 1, 3, and 5 the trips listed in a), b) and c) will be taken at a cost of $7,594 per year. In Years 2 and 4, we will attend the International Conference on Silicon Carbide and Related Materials, which will be held overseas in these years and is shown in d), in addition to those trips listed in a), b), and c) at a cost of $12,254 per year.

Purdue University

School of Electrical
and Computer Engineering

July 11, 1995

Dr. Al Goodman
Office of Naval Research, ONR-312
800 North Quincy Street
Arlington, VA 22217-5660

Dear Dr. Goodman:

In reference to our proposal entitled "Manufacturable Power Switching Devices" (Purdue proposal DSP Y165), we wish to modify the proposed start date to read "29 September 1995 or any time within 60 days thereafter."

Sincerely,

[redacted]

James A. Cooper, Jr.
Professor of Electrical and
Computer Engineering

[redacted]

Louis Pellegrino
Associate Director
Division of Sponsored Programs

Prop 95412--0263
RET #1213[illegible]7---01

Purdue Research Foundation

ORIGINAL

Division of
Sponsored Programs

REF: DSP No. Y165

July 10, 1995

Dr. Al Goodman
MURI '95/ONR 312
Office of Naval Research
800 N. Quincy Street, Room 607
Arlington VA 22217-5660

Dear Dr. Goodman:

Enclosed please find four (4) copies of a revised budget for the proposal entitled ***Manufacturable Power Switching Devises***.

Any award resulting from this proposal should be made to Purdue Research Foundation.

Please refer technical questions to Professor James A. Cooper, Jr. at Purdue University, West Lafayette, Indiana (317/494-3514). Fiscal questions should be referred to Ms. Kathleen Poindexter, Assistant Project Administrator, Office of Contract and Grant Business Affairs, Purdue University, West Lafayette, Indiana (317/494-1078). If I can be of assistance, I can be reached at 317/494-6200.

Favorable consideration of this proposal will be appreciated.

Sincerely,

[redacted]

Louis Pellegrino, Ph.D.
Associate Director
Division of Sponsored Programs

Enclosures
cc: J. A. Cooper
M. R. Melloch
J. M. Woodall
J. L. Gray
D. Landgrebe
W. H. Stevenson

A & T NUMBER: 1213012-X-01 FRC: Orig AMOUNT: $1,400,000

To: ONR 25
Date: 14 July 95

1. Performer Purdue Research Foundation (James Cooper)

2. Incremental funding: ____ yes ✓ no

3. Instrument Type:

____ contract
✓ grant
____ government order
____ purchase order
____ OMNI contract

____ project directive
____ work request
____ request for contractual procurement
____ operating budget
(if one of the 4 above, forward directly to ONR 82)

4. Basis for selection:

____ unsolicited
____ sole source
____ other (please specify) ____________

✓ Broad Agency Announcement solicitation
____ RFP solicitation

5. Fiscal year 1995 and expiration date of the funds 30 Sept 1995

[redacted]
Program Officer
(please forward to ONR 25)

To: ONR 82
Date: 7-14-95

Approval X Disapproval ____________

____________ Extension is required until ____________.

X Extension is not required.

[redacted]
for Dennis Padilla, Director, Contract and Grant Awards Division
(please forward to ONR 82)

[redacted] 7/14/95

Table of Contents

1. Abstract

Power switching devices are reaching fundamental limits imposed by the low breakdown field of silicon, and substantial improvements can only be achieved by going to semiconductors with a higher breakdown field. Two materials with higher breakdown fields than silicon are the wide bandgap semiconductors silicon carbide (SiC) and gallium nitride (GaN), where "GaN" can also include the ternary compounds $Al_xGa_{1-x}N$. Recent progress in these semiconductors makes it seem likely that a manufacturable power device technology can be developed within the next 3 – 5 years. Of the two families, SiC is the most mature and the closest to practical device implementation.

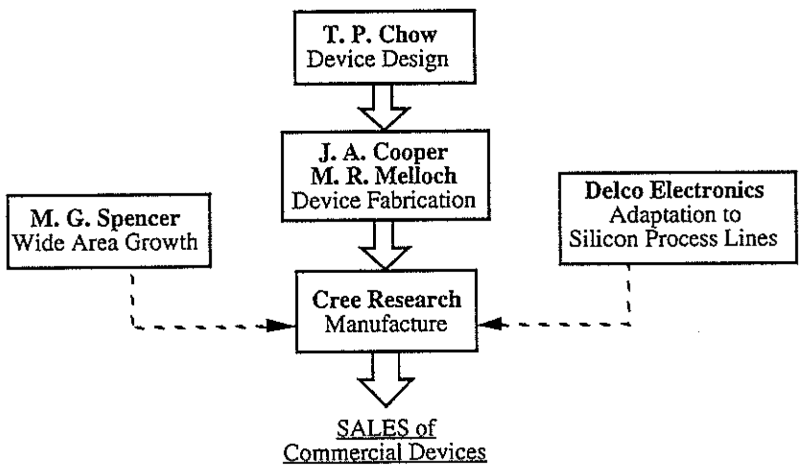
SiC is unique among compound semiconductors in that its native oxide is SiO_2, the same oxide as silicon. This means that the workhorse power devices used in silicon, i.e. the power MOSFET, insulated gate bipolar transistor (IGBT), and MOS-controlled thyristor (MCT) can all be fabricated in SiC. However, because of technological differences, power devices in SiC will be very different from silicon devices, and a direct translation of silicon concepts to SiC is not always possible. SiC has a breakdown field 8x higher than silicon, and SiC power devices can have specific on-resistances 100 – 200x lower than similar devices in silicon. However, several practical problems must be solved before such devices can be realized. Bipolar devices in SiC (e.g., the IGBT and MCT) suffer from short minority carrier lifetimes, which are typically in the range of 40 – 400 ns. As a result, the highest current gains yet reported in SiC bipolar transistors are in the range of 10 – 12. To build high-performance bipolar switching devices in SiC, it will be necessary to increase the minority carrier lifetimes. We propose to do this by a tightly-coupled program of materials research and defect characterization. For MOS devices (including IGBT's and MCT's), the quality of the oxide/semiconductor interface is crucial. The best SiC MOS devices achieved to date have interface state and fixed charge densities about 3x higher than silicon devices. Because the SiC crystal lattice is anisotropic, surfaces perpendicular to the c-axis have either all silicon atoms (the Si-face) or all carbon atoms (the C-face), while surfaces perpendicular to the a-axes have equal numbers of silicon and carbon atoms. MOS interfaces formed on sidewalls perpendicular to the a-axes have interface state and fixed charge densities about 10x higher than on the Si-face. These surfaces form the active interface in vertical power UMOSFET's. To build high-performance MOSFET's in SiC, the MOS interfaces need to be improved, especially interfaces on the a-axis sidewalls. We note that the best SiC bipolar transistors, the best SiC thyristors, the best SiC UMOSFET's, and the best MOS interfaces have all been achieved by members of our research team.

The compounds GaN and AlGaN have high breakdown field and high carrier mobility, and would appear to be ideally suited for power device implementation. However, these III-V nitride compounds do not possess a native oxide similar to SiO_2, so true MOS devices will not be feasible. In addition, the nitrides suffer from the lack of a suitable lattice-matched substrate for crystal growth, and hence the material is in a more primitive state of development than SiC. We believe the nitrides offer great potential for power devices, assuming that several fundamental material problems can be solved. In the nitride portion of this proposal we will concentrate on solving these materials problems. We note that the highest quality GaN grown by any technique on any substrate has been achieved by a member of our research team.

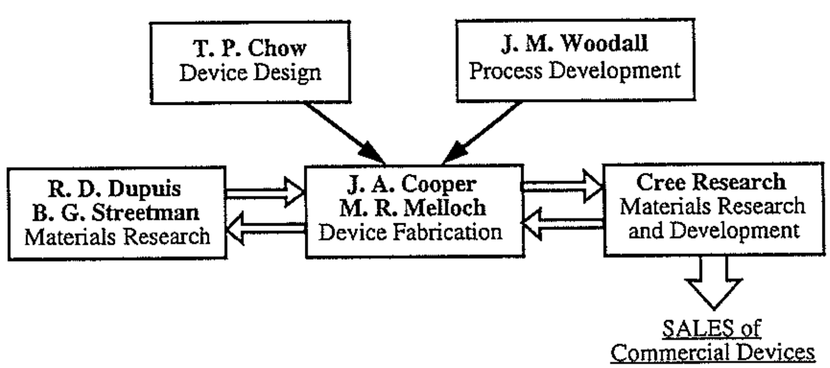
We have assembled a world class team consisting of the leading experts in power device design, SiC and III-V device fabrication, SiC materials research, SiC MOS research, and III-V nitride materials research. Our goal is to enhance the competitiveness of US companies relative to the growing activities in Europe and Japan, and we have involved several leading US companies in our program. These relationships include student internships with Motorola, a joint feasibility study with Delco Electronics, and the inclusion of Cree Research as a full partner on our team. We understand the technical problems which must be solved, and we have creative approaches to each of these problems. Most importantly, our proposal provides a direct path to take wide-bandgap power device technology from research to development to commercial production through the participation of Cree Research.

2. Overview of the Proposal

Silicon carbide materials and device technology has matured to the point that development and manufacture of power switching devices can be seriously contemplated. Our proposal offers a direct path to take SiC devices from research to development to manufacture. Power device design will be conducted by **T. Paul Chow** of Rensselaer Polytechnic Institute (formerly a member of the GE power device group). SiC device fabrication will be conducted by **James A. Cooper, Jr.** and **Michael R. Melloch** of Purdue University. Cooper and Melloch have been leaders in the fabrication of novel SiC devices since 1991. Power devices developed under this program will be manufactured and sold by **Cree Research**. **Michael G. Spencer** of Howard University will investigate wide-area growth of SiC directly on silicon wafers, and **Delco Electronics** will collaborate in a study of the feasibility of processing SiC wafers on existing silicon fabrication lines. The main development path for SiC power devices is illustrated below.



The III-V nitride materials GaN, AlN, and the ternary AlGaN show great promise for power device applications in the long term, but several materials and fabrication problems need to be solved before these devices can be commercialized. Materials research on growth of III-V nitrides will be conducted by **Russell D. Dupuis** and **Ben G. Streetman** of the University of Texas at Austin. Dupuis will investigate growth by MOCVD, and Streetman will study novel approaches to growth by MBE. **Cree Research** will act as a third source of nitride material for this project, and, pending success of this program, will eventually manufacture and market these devices. **Jerry M. Woodall**, formerly of IBM and now at Purdue University, will apply 30 years of materials research experience to developing processing technology for the nitrides. **Paul Chow** will study novel device designs for the III-V nitrides, and **James Cooper** and **Michael Melloch** will conduct device fabrication. The III-V research plan is illustrated below.



3. Introduction and Background

The ideal power switching device would conduct infinite current with zero voltage drop in the on-state and block infinite voltage with zero leakage current in the off-state. The device could be switched from the conducting to the blocking state in zero time by a control voltage driving an infinite input impedance. Real devices, of course, have a non-zero specific on-resistance, $R_{ON,SP}$ [Ω-cm^2] and a non-infinite blocking voltage V_{MAX}.

Semiconductor switches can be realized in many forms: bipolar junction transistors (BJT's), insulated-gate bipolar transistors (IGBT's), MOS field-effect transistors (MOSFET's), and a variety of thyristors and MOS-controlled thyristors (MCT's). Despite operational differences, each of these devices withstands the large blocking voltage in the off-state using a reverse-biased pn junction. In order to keep the peak electric field in the junction below the critical field for semiconductor breakdown E_{BR} (which is a fundamental property of the semiconductor material), one side of the pn junction is very lightly doped and very thick, so that the depletion region extends many microns when the junction is reverse biased. This lightly-doped region is referred to as the "drift region". Unfortunately, the resistance of the thick, lightly-doped drift region usually dominates the overall device resistance in the on-state. Therefore, one faces a trade-off: higher blocking voltages in the off-state inevitably result in higher resistances and larger voltage drops in the on-state.

Silicon power devices have reached the point where practical devices are now approaching the theoretical limit imposed by the silicon breakdown field E_{BR}. To make further progress, it will be necessary to circumvent this fundamental limitation by building devices in a semiconductor with a higher breakdown field. Two materials which have substantially higher breakdown fields than silicon are silicon carbide (SiC) and the ternary compound aluminum gallium nitride ($Al_xGa_{1-x}N$). Considerable progress has been made in both material systems in the last several years, but at this point in time the most mature system is SiC.

SiC is one of the hardest and most thermally stable materials known to man. It is also the only compound semiconductor that can be thermally oxidized to form a high quality native insulator: SiO_2. The availability of this thermal oxide makes it possible to fabricate MOSFET's, IGBT's, and MCT's in SiC. Equally important for power switching devices, SiC has a breakdown field E_{BR} that is about eight times higher than silicon.

Since the peak electric field can be 8x higher than in silicon, SiC switching devices can be fabricated with a drift region about 8x thinner than comparable silicon devices. If the drift region is 8x thinner, the doping of the drift region can be about 12x higher. The resistance of the drift region is proportional to the thickness and inversely proportional to the doping, so the specific on-resistance of a SiC device can be from 100 - 200x smaller than a comparable silicon device of equal voltage rating. This means the SiC device can be 100 - 200x smaller than the comparable silicon device. Alternatively, if the SiC device has the same area as the comparable silicon device, its specific on-resistance will be 100 - 200x lower.

Although it offers substantial advantages over silicon, SiC is still immature as a semiconductor material. Single crystal wafers of SiC have only been commercially available since 1991, and a number of technical problems need to be addressed before SiC can supplant silicon in power device applications. The main problems are related to crystal growth of SiC materials. Because of the very high melting point, single crystal boules cannot be pulled from a melt as in the Czochralski method used for silicon. Instead, the boule is grown on a seed crystal by a high temperature sublimation process pioneered in the USSR and introduced commercially in the US by Cree Research, Inc. At present, the boules grown by the sublimation process are limited to about 2 inches in diameter, much smaller than the 6 to 8 inches common in the silicon industry. In addition, the material still has a relatively large number of defects. These defects include micropipes, micron-size holes which run completely through the wafer. Fortunately, the micropipe problem appears to be under control, with micropipe densities as low as 27 cm^{-2} in the most recent wafers, and at the current rate of improvement micropipes should be completely eliminated within 3 to 5 years. The remaining defects may still pose a manufacturing problem for power devices, since they limit the size of device which can be manufactured with reasonable yield. We will propose a novel approach called "adaptive manufacturing" that will allow us to achieve high yield on large power devices even in the presence of material defects.

SiC crystallizes in the hexagonal lattice with alternating planes of silicon and carbon atoms. The Si-C plane-pairs can occur in three orientations, labeled A, B, and C. The particular stacking sequence of Si-C plane-pairs identifies the *polytype* of the crystal. SiC occurs in a variety of polytypes, but the most common are 3C, 4H, and 6H. At the present time, the 6H polytype is the most thoroughly characterized, but the 4H polytype is more attractive for power devices because of its higher electron mobility. In this program we will investigate both the 6H and 4H polytypes, but we will place our major emphasis on the 4H polytype.

Although it has a much higher breakdown field than silicon, SiC has lower hole and electron mobilities and shorter minority carrier lifetimes. The shorter lifetimes allow bipolar devices in SiC to switch much faster than comparable silicon devices, but they limit the current gain of SiC bipolar transistors to very low values, typically less than 20. **In order to improve the performance of bipolar devices, we need to increase the minority carrier lifetimes in SiC.** For high-speed switching with low forward voltage drop, the best SiC device will be a power MOSFET. However, **to develop a manufacturable MOSFET process, we need to understand and optimize the MOS interface between thermally grown SiO_2 and SiC.** We also need to investigate the long term stability and reliability of the interface under high-field stress conditions. Purdue is currently recognized as a world leader in SiC MOS technology, having produced SiO_2/SiC interfaces with the lowest interface state and fixed charge densities ever reported.

The III-V nitride semiconductors in the $Al_xGa_{1-x}N$ family have superior electrical properties which should make them ideally suited for power device applications. Calculations predict a saturation velocity of 2.8×10^7 cm/s and a low-field mobility of 800 cm^2/Vs for electrons in GaN [1]. Although not yet confirmed, the breakdown field is expected to be at least comparable to SiC. In addition, the availability of heterojunctions in this material system may permit the fabrication of novel devices such as heterojunction bipolar transistors (HBT's) and heterojunction field-effect transistors (HFET's), and the high dielectric constant of AlN (~9.1) will enhance the transconductance of field-effect devices.

At the present time, the III-V nitrides suffer from serious problems with material quality, mostly arising from the lack of a suitable lattice-matched substrate for epitaxy. **To develop practical power devices in the III-V nitrides, we need to solve these materials problems.** Our III-V nitride materials research will be led by R. D. Dupuis and B. G. Streetman at the University of Texas at Austin, where Dupuis has produced the highest quality GaN grown by any technique on any substrate. Cree Research is currently developing III-V nitride technology for blue light-emitting diodes (LED's), and will act as a third source of material for this project.

4. Status of SiC Device Technology

4.1. Recent History

Cree Research was founded in 1987 to bring SiC semiconductor materials and device technology to the commercial market. The founders were able to attract start-up capital because of their strong patent position in the growth technology for single-crystal SiC. Sales of the company's initial product, a SiC blue light emitting diode (LED), were beyond expectations, and Cree is now shipping over one million blue LED's per month. In 1991, Cree began commercial sales of 1 inch diameter wafers of the 6H polytype of SiC. The availability of these wafers sparked a number of research and development programs worldwide, particularly in Europe and Japan. **Our MURI proposal is designed to strengthen the position of US companies with respect to European and Japanese competitors in this strategic enabling technology.**

Purdue became involved in SiC device development when J. A. Cooper and C. H. Carter met at a BMDO program review in June 1990. For several years, Purdue had been working on one-transistor dynamic memories in GaAs under BMDO sponsorship. The GaAs program had been highly successful: since the beginning of the program, Purdue had increased the room temperature storage time of the GaAs memory cells from 30 sec to over 10 hours, equivalent to an order of magnitude improvement every two years. Under the encouragement of M. N. Yoder of ONR, Purdue and Cree submitted a joint proposal to develop similar memory cells in SiC, where the large bandgap would permit long-term nonvolatile storage. Under a $4.2M BMDO program, which was awarded in March 1993, Purdue and Cree have collaborated on fabrication technology and novel devices in SiC, solving many of the technological problems associated with new SiC devices. As a result of this activity, **Purdue has assembled the largest SiC research group of any university in the country**. Cree also has a substantial device development program in-house. Very recently Cree received commitments from ARPA for a new $6.9M materials research program to improve SiC crystal growth technology. We believe that our history of collaboration and our current SiC research activities place us in an excellent position to develop SiC power switching devices under the MURI program.

4.2. Status of SiC Fabrication Technology

Because SiC has such high thermal stability and is resistant to all known chemical etchants, SiC device processing often requires different techniques from those normally used in silicon processing. The seven basic unit processes are:

a. Epitaxy
b. Selective-area doping
c. Anisotropic etching
d. Thermal oxidation
e. Deposition of thick field oxides
f. Ohmic and Schottky contact formation
g. Metal and polysilicon deposition

(a). Epitaxy of SiC is normally accomplished by chemical vapor deposition (CVD). Cree Research sells both 4H and 6H-SiC wafers with customer-specified epilayers. These layers can be nitrogen doped (n-type) or aluminum doped (p-type) at doping levels from 10^{14} cm^{-3} to > 10^{20} cm^{-3}. Howard University conducts research in wide-area growth of 3C-SiC on Si wafers, and Purdue is currently installing an Aixtron AIX 200/4 MOCVD system for SiC epitaxy.

(b). Selective-area doping is accomplished by ion implantation. This is necessary because thermal diffusion coefficients in SiC are too small for diffusion of impurities to be practical. SiC can be implanted to $>10^{19}$ cm^{-3} with nitrogen (n-type) and with either boron or aluminum (p-type). Implantation is conducted with the wafer at an elevated temperature, and the implants are activated at 1200 – 1500 °C in argon. (Note that at 1500 °C, a silicon wafer would melt!) Purdue and Cree use an external vendor for ion implantations, but perform activations in-house at both locations.

(c). Anisotropic etching is by RIE. Any fluorinated gas can be used, including NF_3, SF_6, etc. The Purdue system employs SF_6 while Cree uses NF_3. An early problem reported by several investigators was micromasking caused by aluminum particle contamination during RIE of SiC. We have eliminated this problem by adding a graphite cover plate over the aluminum cathode in the RIE chamber. We now obtain highly anisotropic profiles in 6H-SiC to a depth of tens of microns. The surface morphology of the etched surfaces is good.

(d). Thermal oxidation. MOS oxides are critical elements of most semiconductor devices, particularly power devices, and Purdue is widely regarded as the leader in MOS oxidation of SiC. The important figures of merit are the interface state density D_{IT}, the fixed charge density Q_F, and the breakdown field E_{BOX}.